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Comparison of whole and dehulled seeds of different sunflower hybrids for bread making characteristics

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ABSTRACT

Six sunflower hybrids developed in Pakistan were chosen for the present study to distinguish for proximate composition and bread baking properties. The data obtained for all the studied quality attributes were statistically analyzed. It was found that moisture, ash, fat and protein contents increased after dehullling while crude fiber contents decreased. The results concerning sensory evaluation of pan breads prepared from whole sunflower seeds flour and dehulled sunflower seeds supplemented wheat flour indicated that all the external and internal sensory attributes were affected as the level of supplementation of both types of sunflower seeds increased. The scores assigned to taste, aroma and color of crust of breads prepared from freshly prepared composite flour from dehulled seeds was increased while score for all other parameters decreased than control. The breads prepared with dehulled seeds up to 14% level of supplementation in wheat flour found to be acceptable with respect to all sensory attributes. In the present study significant improvement in the proximate composition (ash, fat, crude protein and crude fiber) of sunflower seeds supplemented wheat flours was observed.

Keywords: Sunflower seeds; hybrids; bread; supplementation

INTRODUCTION

Oilseeds have been set up with increasing demand as go on a diet from last few decades because they have been confirmed to be rich in components priceless for human health. Sunflower (*Helianthus annuus* L.) is one of the most key oilseed crops [1]. Sunflower oil is ranking fourth with a worldwide production of about 10.6 million metric tonnes in 2006 [2]. Per 100g the seed is made-up to enclose protein 20.78g, total lipid (fat) 51.46g, ash 3.02g, carbohydrate 20g and fiber 8.6g with total energy of 2445kj [3].

The production of sunflowers is increasing in Pakistan. During the year 2007-08, sunflower crop occupied an area of 1130,000 acres and production was 683,000 tonnes with oil production of 264, 000 tonnes. While in the year 2008-09, sunflower crop was grown on an area of 1250,000 acres and its production was 755,000 tonnes with oil production of 287,000 tonnes [4].

Bread and bakery products have an important role in human nutrition. Generally, wheat bread is considered to be a good source of energy and irreplaceable nutrients for the human body. Bread prepared from refined flour is nutritionally much poorer and does not adequately meet the requirements for many macro- or micro-nutrients. It has been reported that bread made from refined flour has low micronutrient content [5].

Also, wheat protein lacks the balance of essential amino acids- lysine, threonine and valine. Therefore, there have been many on-going investigations on enhancing the nutritive value of bread to fulfill the expanding demands of modern dietary habits, considering the products' protein, mineral, vitamins and/or fiber contents.

To a large extent research has been done on the agronomic aspects of sunflowers, but studies on the dietary aspects of sunflower seeds are inadequate. The sunflower seeds are not extensively produced in Pakistan. In recent times plant breeders are working on the expansion of new and high yielding varieties/ hybrids of sunflower. There is a awful need that research should be done to discover the nutritionally superior quality hybrids/ varieties of sunflower. The at hand project was undertaken to evaluate some of the hybrids produced by Ayub Agricultural Research Institute, Faisalabad with main objectives to characterize sunflower seeds for chemical composition and to use these seeds in bread.

MATERIALS AND METHODS

The research work was conducted to characterize the sunflower hybrids and assess their suitability for the preparation of bread. The detail of the research plan is described here in after:

Procurement of raw material

Sunflower seeds of different hybrids (FH-37, FH-106, FH-237, FH-259, FH-331, FH-369) were purchased from the Oil Seed Research Institute, Ayub Agricultural Research Institute, Faisalabad, Pakistan. These sunflower seeds were divided into two parts. Half of the seeds were used as such (with hull) while the rest half was dehulled for further studies. Seeds were dehulled manually.

Proximate composition of raw materials

The whole sunflower seeds and sunflower seeds after dehulling were analyzed for their moisture content Method No. 44-15A, crude protein Method No. 46-30,

crude fat Method No. 30-10, crude fiber method No. 32-10 and ash content Method No. 08-01, described in AACC [6].

The NFE was calculated according to the following expression:
NFE = 100 – (% moisture + % crude protein + % crude fat + %crude fiber + % ash)

Preparation of seed flour
The sunflower seeds were ground in china chakki and grounded samples were was smashed and passed through a 200-mesh sieve to obtain flour, which was packed in polypropylene bags for further studies.The wheat flour was replaced with sunflower seed flour for blends formulation at different levels as given herein.

Formulation of sunflower seed flour supplemented flour blends

Treatments	Wheat Flour (%)	SS Flour (%)
T_0	100	0
T_1	94	6
T_2	90	10
T_3	86	14

The choice of the above levels of sunflower seeds four was based on the report of Skrbic and Filipcev [7].

Preparation of breads
The bread dough formula was: flour (refined) (100%), compressed yeast (2%), salt (2%), sugar (3%), shortening 5% and sunflower seed was tested at (6%, 10%, 14% levels). Percentages are based on flour weight. The bread-making performances of flours (control and blends) were determined using straight dough AACC method [6].

Bake trials was carried out under laboratory conditions. Dough mixing, processing and baking was per-formed on laboratory-scale equipment. A straight dough process was used. After mixing, proofing for 20 minutes was done. After proofing, shaping, moulding and panning final proofing was done at 37^{o}C and 80-90% relative humidity. Breads were baked at 235 ^{o}C for 20-40 minutes.

Organoleptic evaluation of sunflower seeds supplemented breads
The subjective evaluation of bread samples was carried out for the external sensory characteristics i.e. volume, color of crust, symmetry of form, evenness of bake, character of crust and internal characteristics like grain, color of crumb, aroma, taste and texture by a trained panel of five judges using score card. The products were scored by the judges according to the method described by Matz [8].Based on the results of sensory evaluation of breads, three best bread showing suitability for product preparation, along with control were selected for further analysis. The bread samples were analyzed for ash, crude protein, crude fat and crude fiber according to their respective methods of AACC [6].

Statistical analysis
The data were interpreted by analysis of variance (ANOVA) using M-Stat C software package [9]. The Duncan's Multiple Range test was used to determine the level of significance that existed between the mean values.

RESULTS AND DISCUSSION

Six hybrids of sunflower grown in Pakistan were selected for the present studies to characterize for proximate composition and technological (bread baking) properties. The data obtained for all the studied quality attributes were statistically analyzed and the results are interpreted and discussed in the following sections.

Proximate composition of sunflower seeds
The moisture, ash, crude fat, crude protein, crude fiber and nitrogen free extract were found in the range from 5.06 to 6.32 % and 6.13 to 7.72 %, 2.68 to 3.13% and 3.54 to 3.94%, 26.47 to 34.95% and 37.36 to 46.60%, 17.18 to 22.96% and 21.86 to 26.69%, 25.86 to 35.90 % and 11.78 to 16.81 % and 7.68 to 13.78% and from 5.76 to 8.04% in whole seeds and dehulled seeds respectively among different sunflower hybrids.

On account of proximate composition FH-259 was found to be best.

It is clear from results that after dehullling there is a significant increase in all constituent except crude fiber which is high in hull of the seeds as nitrogen free extract. The higher amount of moisture, protein, ash, fat and all mineral contents in dehulled seeds as compared to whole seeds in the present study may be ascribed to the fact that probably the hull contains fewer amounts of these while it is rich in crude fiber. Similar finding were also found by some other scientists. There is an increase of moisture contents from 5.50 to 6.54% ash content 3.49% to 7.05%, fat content from 37.47 to 62.35% and protein content from 18.72% to 19.30% of respectively whole seeds to dehulled seeds among different sunflower seeds. There is decrease of fiber contents from 28.36 to 13% and for nitrogen free extract 6.11% to 3.50%when sunflower seeds were dehulled [10]. The results are also supported by the studies of Bhagya and Sastry [11].

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Table 1 Proximate composition (%) of whole and dehulled seeds of different sunflower hybrids

Hybrids		FH-37	FH-106	FH-237	FH-259	FH-331	FH-369
Moisture	WS	4.88±0.80c	5.72±0.28ab	3.06±0.83d	5.60± 0.55ab	6.32± 0.74a	6.20±0.00a
	DS	6.34±0.25d	6.66±0.76c	6.13±0.28e	6.37±0.23d	7.72±0.15a	7.01±0.16ab
Ash	WS	2.95±0.62c	3.07±0.14ab	2.97±0.84c	3.13±0.02a	2.68± 1.06d	2.97±0.18bc
	DS	3.54±0.84c	3.90±0.04ab	3.76±0.21b	3.83±0.61b	3.03±0.18d	3.94±0.23a
Crude Fat	WS	32.93±1.38ab	29.67±1.43abc	26.47±1.80c	27.18±0.78bc	32.13±1.14a	34.95±0.61a
	DS	39.27±1.03d	42.31±0.54c	42.21±0.50c	37.36±1.87d	51.58±1.45a	46.60±0.86b
Crude Protein	WS	19.32±0.52bc	19.87±1.29bc	22.96±0.02a	19.22±1.44bc	21.91±0.05ab	17.18±1.10c
	DS	23.60±1.75bc	22.64±1.82 bc	24.45±2.10b	26.69±2.47a	26.86±1.53a	18.64±0.82d
Crude Fiber	WS	31.25±0.92b	30.86±1.99b	28.84±1.84bc	35.90±0.09a	25.86±0.45c	27.45±0.45bc
	DS	14.30±1.74c	16.73±1.10ab	16.53±0.85b	16.81±1.25a	14.77±1.88c	11.78±0.95d
NFE	WS	7.68±0.36e	10.81±1.71c	13.71±0.95a	8.98±0.32d	11.11±1.32bc	11.26±1.98b
	DS	5.95±1.54c	5.76±0.90cd	6.92±0.26b	6.95±1.44b	8.04±0.18a	6.03±1.34c

WS Whole seed
DS Dehulled seeds
Values are mean ± SD
Any two means not sharing same letter differ significantly from each other

Table 2 Means for external characteristics of bread

	VOLUME		Color of Crust		Form Symmetry		Evenness of bake		Crust Character	
Treatments	ws	DS	WS	DS	WS	DS	WS	DS	WS	DS
T0	8±0.00a		6.6±0.89a		4±0.00a		2.8±0.45a		2.8±0.55a	
T1	6.8±0.84a	7.2±0.45ab	6±1.58a	6.4±1.14a	2.8±0.84a	3.6±0.55ab	2±0.00ab	2.4±0.55b	2.4±0.55a	2.6±0.55ab
T2	5.6±0.55b	7.2±1.10ab	5.8±1.10ab	6.6±1.52a	2.6±0.55ab	3.6±0.55ab	1.8±0.45bc	2.2±0.45b	1.8±0.45ab	2.5±0.45ab
T3	3.8±0.84c	6.8±0.84b	4.2±1.10c	6.6±1.52a	2.2±1.30c	3±0.71b	1.4±0.55c	2.2±0.45b	2.2±0.45b	2.5±1.00b

WS Whole seed
DS Dehulled seeds
Values are mean ± SD
Any two means not sharing same letter differ significantly from each other

Table 3 Means for internal characteristics of breads

	Grain		Color of crumb		Aroma		Taste		Texture	
Treatments	WS	DS	WS	DS	WS	DS	WS	DS	WS	DS
T0	12±1.22a		7.8±0.45c		7.2±1.10c		15.8±3.56a		12.8±0.84a	
T1	10.2±0.45ab	12.6±0.89a	7.2±1.10ab	7.8±0.84ab	7±1.22a	8±0.71ab	14.4±1.14a	16.4±2.07a	10.2±1.64b	12.6±0.84a
T2	8.4±2.70b	12±1.00a	6.2±1.10b	8.8±0.84b	7.4±0.84a	8.8±0.45b	12.8±2.86a	16.8±1.64a	8.8±2.49b	12.4±1.14ab
T3	6±0.00c	11.4±1.52a	4±1.22c	9.2±0.84a	7.6±1.34a	9.6±0.55a	8.6±0.55b	18.2±1.48a	5.6±1.95c	10.8±1.92b

WS Whole seed
DS Dehulled seeds
Values are mean ± SD
Any two means not sharing same letter differ significantly from each other

Table 4 Effect of sunflower seeds supplementation on proximate composition of bread

Supplementation level	Crude protein (%)	Crude fat (%)	Crude fiber (%)	Ash (%)
100% wheat flour	14.36±0.56d	1.75±0.21d	0.58±0.33c	0.92±0.06d
Wheat flour + 6% SS*	14.59±0.74c	6.30±0.57c	1.47±0.04b	1.18±0.01c
Wheat flour + 10% SS*	15.05±0.50b	11.00±0.71b	2.40±0.02a	1.27±0.01b
Wheat flour + 14% SS*	15.62±0.17a	13.40±0.71a	2.44±0.03a	1.38±0.01a

WS Whole seed, DS Dehulled seeds, Values are mean ± SD, Any two means not sharing same letter differ significantly from each other,
SS* Sunflower seeds

Sensory evaluation of wheat bread supplemented with sunflower seeds

The present study regarding sensory evaluation of pan breads prepared from whole sunflower seeds flour and dehulled sunflower seeds supplemented wheat flour indicated that all the external and internal sensory attributes were affected as the level of supplementation of both types of sunflower seeds increased. The scores assigned to taste, aroma and color of crust of breads prepared from freshly prepared composite flour from dehulled seeds was increased while score for all other parameters decreased than control.

The quality of breads based on sensoric attributes is described by appearance, aroma, texture and flavor [12] Wang *et al.* [13] have concluded that addition or increase of dietary fiber in breads results in the decrease in loaf volume and darker crumb appearance of bread. Whole seeds have more crude fiber that's why darker color has in the present study. Filipovic *et al.* [14] also found that incorporation of fibers (modified and unmodified) showed decrease in scores assigned to volume and crumb quality of bread.

The sensory scores for appearance, texture and flavor of breads have been reported to be decrease by the incorporation of non wheat flours in wheat flours [15]. The results of the present study are in conformity with the work of Skrbic and Filipcev [7] who found that addition of different levels of sunflower seeds in bread negatively affected the volume. But these results for flavor of bread are in contrast with Shittu *et al.* [15] for flavor and taste and similar to Skrbic and Filipcev [7].

In the present study, assignment of higher score by the panelists to the crust and crumb colour, flavor and taste of breads may be attributed to the lighter yellow color of dehulled kernel and presence of more phenolic compounds in dehulled seeds. It is a common choice in Pakistan that consumers like breads with light brown crust and whiter crumb. This factor might have affected the psyche of panelists when rating the breads with higher levels of flaxseed and they assigned lower scores with respect to their color.

The decrease in bread firmness and reduction in volume scores may be ascribed to the decrease in gluten forming proteins and increase in dietary fiber contents contributed by sunflower seeds, which negatively affected the formation of gluten network and depressed the loaf volume due to lack of gas retention capacities of the composite flour. The decrease in character of crust, evenness of bake, and texture and grain scores of breads prepared from whole seeds and dehulled seeds supplemented wheat flour may be attributed towards the coarser grain structure of sunflower seeds flour and more fiber contents of sunflower flour which resulted in the formation of leathery texture and coarser bread grain. The increase in taste and aroma of breads by the increase in level of sunflower flour supplementation might be due to more flavoring compound present in sunflower seeds. The breads prepared with dehulled seeds up to 14% level of supplementation in wheat flour found to be acceptable with respect to all sensory attributes. The breads with sunflower flour supplementation will be superior in nutritional quality and provide more health benefits than normal wheat bread.

Selection of sunflower seeds supplemented breads

Selection of breads prepared from maximum acceptable levels of sunflower seeds in wheat flours was made on the basis of sensory acceptability. The results of the sensory studies revealed that breads prepared from composite flours of dehulled seeds at all the levels of supplementation were found to be acceptable for their overall acceptability. The breads prepared from composite flours of dehulled seeds in wheat flour were selected for further studies. The bread prepared from 100% wheat flour was also used as control.

Chemical composition of wheat breads supplemented with sunflower seeds

The chemical composition provides basic information about the components and quality of the products. The ash content of different type of breads indicated that increase in the level of sunflower seeds supplementation in wheat flours resulted in a significant increase of ash content in the breads. It is evident form the results given in Table 4 that addition of sunflower seeds at 14% contributed towards more increase in ash content (1.38%). The ash content significantly increased from 0.92 at 0% in control, 1.18 at 6%, 1.27% at 10% and 1.38% at 14% level of supplementation. Results also indicate that addition of sunflower seeds at 14% contributed towards more increase in fat content (13.40%). The fat content significantly increased from 1.75 at 0% (control), 6.30 at 6%, 11% at 10% and 13.40% at 14% level of supplementation. Also the addition of sunflower seeds at 14% contributed towards more increase in crude fiber content (2.44%). The crude fiber content significantly increased from 0.58 at 0% (control), 1.47 at 6%, 2.40% at 10% and 2.44% at 14% level of supplementation. The results for supplementation levels at 10% and 14% were statistically found to be similar. Addition of sunflower seeds at 14% contributed towards more increase in crude protein content (15.62%). The crude protein content significantly increased from 14.36 at 0% (control), 14.59 at 6%, 15.05% at 10% and 15.62% at 14% level of supplementation.

The supplementation of sunflower in wheat flour significantly improved the nutrient profile of the breads. The results of the present study are in line with the earlier study conducted by Skrbic and Filipcev [7] in which they found significant improvement in the proximate composition (ash, fat, crude protein and crude fiber) of sunflower seeds supplemented wheat flours.

CONCLUSIONS

There is a significant increase in protein, fat, ash and moisture contents of sunflower seeds after dehulling while crude fiber contents decreased. The breads prepared with dehulled seeds up to 14% level of supplementation in wheat flour found to be acceptable with respect to all sensory attributes. The results of the present study indicated that sunflower seeds supplementation into wheat flour improved the chemical constituents of the breads. This reflects the potential for use of sunflower into wheat flour for enhancement of these nutrients/chemical constituents. So baking industry should focus on the fortification of bakery products with sunflower seeds.

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